WILLAMETTE NATIONAL FOREST
BURNED AREA EMERGENCY RESPONSE
2018 TERWILLIGER FIRE

FISHERIES RESOURCE ASSESSMENT

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OBJECTIVES

- Identify fisheries values at risk.
- Assess how overall changes to watershed process and function caused by the fires may affect critical fisheries values.
- Recommend emergency treatments, if needed, to reduce the risk to fisheries values.

I. CRITICAL FISHERIES VALUES AT RISK

The Terwilliger Fire burned within the South Fork McKenzie River 5th Field Watershed within the McKenzie River Sub-basin (Figure 1). Fishes found in streams throughout this watershed includes: spring Chinook salmon, bull trout, cutthroat trout, rainbow trout, Pacific lamprey, western brook lamprey, pacific brook lamprey, largescale sucker, redside shiners, mountain whitefish, dace spp., sculpin spp., and non-native brook trout.

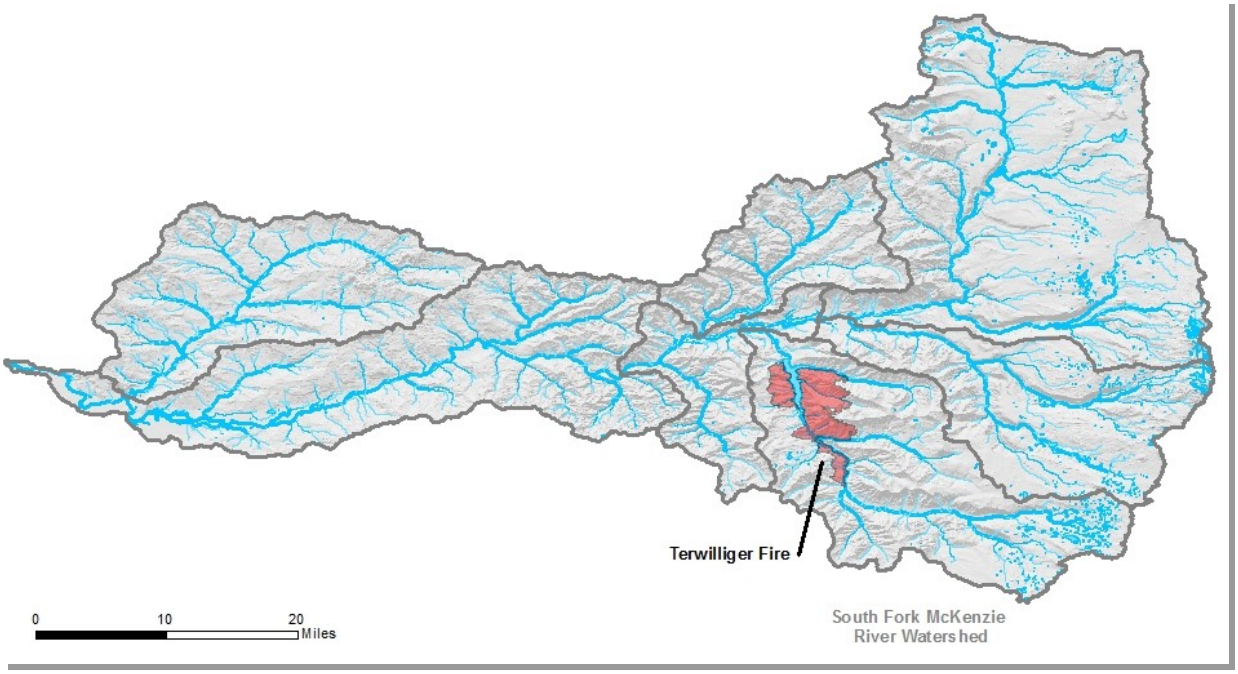

Figure 1. Location of Terwilliger Fire within the South Fork McKenzie River 5th Field Watershed of the McKenzie River Sub-basin.

Streams within and immediately downstream of the fire support two ESA Threatened fishes and their designated Critical Habitat – bull trout and Upper Willamette River spring Chinook salmon (Figure 2). Spring Chinook salmon are the only anadromous species in the South Fork. Adults migrate up the South Fork to the base of Cougar Dam where there is a trap and haul facility operated by the U.S. Army Corps of Engineers. Adults are trucked around Cougar Dam and released above the reservoir to spawn. They spawn throughout the South Fork, in the East Fork of the South Fork, the first mile of French Pete Creek, and in other tributaries.

Fry and juvenile Chinook can rear in natal streams for one to two years before migrating downstream to the Pacific Ocean.

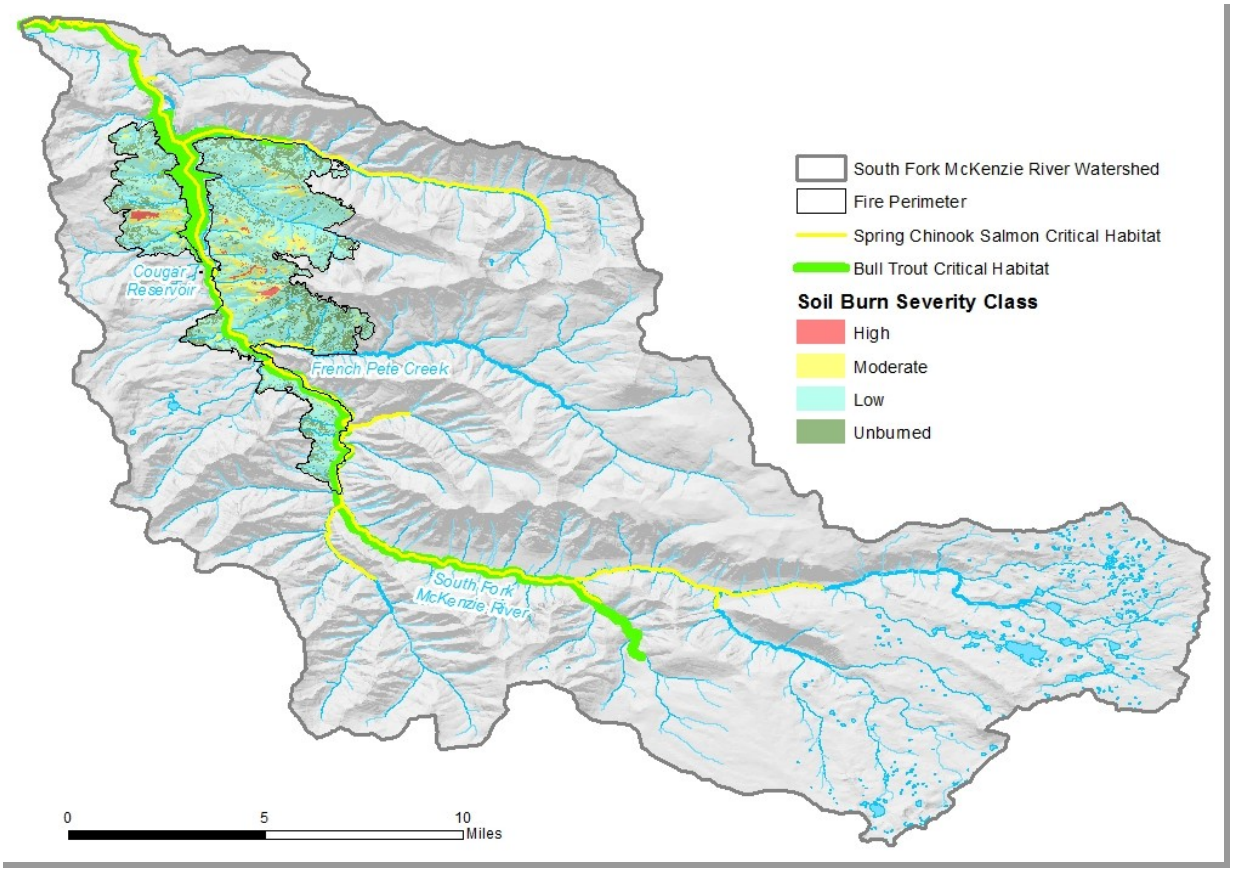

Figure 2. Occupied and designated Critical Habitat for ESA Threatened bull trout and spring Chinook salmon within the South Fork McKenzie River Watershed and near the Terwilliger Fire.

The bull trout population in the South Fork is fluvial and/or adfluvial, meaning they spend most of their adult life in lower parts of the river or reservoir. Bull trout can migrate below Cougar Dam and return to the upper South Fork through the trap and haul facilities. Bull trout will only spawn in very clean, cold spring-fed streams. In the South Fork watershed, the only spawning stream is Roaring River where temperatures don't exceed 8°C. Fry, juveniles, and adults utilize the South Fork extensively for rearing, foraging, and overwintering.

II. THREATS TO CRITICAL FISHERIES VALUES

Potential post-fire effects to the South Fork McKenzie River Watershed include: increased water temperature, peak flows and channel scour, surface erosion and sediment delivery, and landslides and debris flows. These post-fire effects may impact the survival of ESA-listed fish eggs, fry, juveniles and adults downstream of the fire. They may also alter habitat and channel conditions within Critical Habitat.

Due to the close proximity of steep drainages within the burned area there is potential for detrimental impacts to Critical Habitat.

III. PRE-FIRE WATERSHED CONDITION

The Terwilliger Fire is located within the Western Cascades geologic province, characterized by older, less permeable volcanic material. The landscape is significantly more dissected within the Western Cascades, and stream flows are more heavily influenced by rain and snow runoff rather than springs. The Western Cascades are generally more prone to mass wasting due to the steeply incised valleys. High intensity storm and fire events may trigger landslides and debris flows, which occur in steep areas associated with roads, concave slopes, headwalls, and bedrock hollows. Large storm events increase soil moisture on these steep slopes and trigger slope failures. These types of failures deliver coarse grain sediments, rocks and wood to stream channels.

Large woody material is an important component of stream channels due to its ability to store and route sediment and create quality habitat for fish and other organisms. The South Fork within the burned area had low amounts of large woody material and was generally in poor condition. There is a lack of large woody material, habitat diversity, and floodplain connectivity, likely due to historic removal of instream wood. Prior to the fire, however, the South Fork had intact mature riparian areas. The south side of French Pete Creek burned in 2017, but severity was generally low leaving many live mature trees. The fire in 2017 did contribute a substantial amount of large woody material and has since made the stream more complex. During field reconnaissance in 2018 for the BAER assessment, no sign of erosion or mass wasting was observed. The pre-fire condition of East Fork of the South Fork is unknown.

IV. BURNED AREA ASSESSMENT METHODOLOGY

Information for this assessment is based on a review of relevant literature, habitat inventory information, watershed analyses, and professional knowledge as a Willamette National Forest fisheries biologist. Species occurrence is based on formal surveys conducted prior to the fire. Information on the effects of the fire came from burned area field reconnaissance October 9-12, 2018. The BAER team spent multiple days in the field documenting fire effects, testing soil burn severity, locating and assessing the critical values at risk, and developing potential treatments to minimize impacts to critical values.

Once a final soil burn severity map was created, geologic and hydrologic analyses were conducted to locate the areas at increased risk to landslides and debris flows

and estimate the flows and sediment transport from catchments within the burned area following a precipitation event.

V. POST-FIRE EFFECTS TO WATERSHED FUNCTION AND CRITICAL FISHERIES VALUES

Stream Shading and Water Temperature

Increased stream temperatures can occur following wildfires when riparian vegetation is reduced in moderate and high intensity burns. This can result in increased solar radiation and changes in streamside microclimates until enough riparian vegetation can again shade stream channels (Brown and Krieger 1970; Dwire and Kauffman 2003). Changes in water temperatures can be especially problematic during the summer, when solar radiation levels are highest and stream flows are low.

Within the burned area, the majority of high and moderate severity burn occurred on ridge tops or mid-slopes (Figure 3). Most riparian areas burned at low severity and left a large portion of the canopy intact (Figures 3-5). Because nearly all perennial streams still have intact canopy, measureable temperature increases are not expected within Critical Habitat. In the long-term as large wood loading increases in streams within the burned area, so should the recruitment of cobbles and gravels, increasing the hyporheic interaction. It is possible that some streams could see cooler temperatures in the future.

Figure 3. High and moderate soil burn severity on ridge tops and mid-slopes of the Terwilliger Fire. Mostly low soil burn severity in riparian areas along the South Fork McKenzie River.

Figure 4. Low soil burn severity along French Pete Creek (Terwilliger Fire on left side and 2017 Rebel Fire on right side).

Figure 5. Low soil burn severity within the East Fork of the South Fork drainage.

Peak Flows and Channel Scour

According to the hydrologic analysis, overall watershed response to the fires includes: 1) an initial flush of ash; 2) an increase in erosion (as was observed across the fire burn area), 3) a slight increase in peak flows and sediment delivery from the burn area, and 4) potential for increased slope instability in areas prone to instability. As the burn area recovers, watershed response will return to normal levels. Vegetation will provide ground cover, increasing surface roughness and improve infiltration.

Modeled post-fire peak flows in small tributaries across the burned area show slight increases (Table 1). Post-fire flows could potentially lead to plugged culverts, diversion down the road, and gully erosion of roads and the hillside.

Table 1. Comparison of pre- and post-fire hydrologic modeling outputs using 2 year return interval with 24 hour intensity.

Watershed	Watershed acres	Pre Fire Discharge	Post Fire Discharge	Times Increase
1. 170900040307 Cougar Reservoir-SF McKenzie R	132,739	6616.96	6681.82	1.01
2. 170900040305 French Pete Creek	20,149	1828.56	1836.47	1.00
3. 170900040304 Rebel Creek-SF McKenzie River	80,063	4686.74	4693.82	1.00
4. 170900040306 East Fork South Fork McKenzie River	11,750	1265.66	1269.82	1.00
5. Basalt Creek	541	154.94	162.32	1.05
6. Annie Creek	748	193.31	201.38	1.04
7. Boone Creek at Slide	305	104.81	123.23	1.18
8. Terwilliger Hot Springs	109	51.96	53.69	1.03
9. Unnamed Creek Below Rebel Creek Confluence	64	36.08	38.00	1.05
10. Unnamed Creek near Sunnyside Campground	171	70.75	85.22	1.20
11. Smith Creek	464	139.54	157.83	1.13
12. Slide Creek	308	105.49	114.20	1.08
13. Unnamed Creek along FSR 1900-500	200	78.65	88.09	1.12
14. Walker Creek at Lowder Mountain Trail Head	4,940	700.79	735.02	1.05

South Fork McKenzie River, East Fork of the South Fork, and French Pete Creek peak flows are estimated to increase only 1%, 0.3%, and 0.4%, respectively. Expected increases in peak flows will not likely exceed channel capacity and result in stream bank erosion and/or channel instability in streams with ESA-listed fish or exacerbate scour of spring Chinook salmon redds, impact juveniles, or substantially alter channel conditions. Miles of unburned channel, intact riparian area, and other depositional areas would help diminish post-fire effects to Critical Habitat.

Large Woody Debris

Based on field surveys, some wood recruitment to valley bottom fish-bearing streams occurred immediately following the fire (Figures 6 and 7). Hillslope drainages also received a lot of wood loading and may eventually deliver that wood to larger valley bottom streams (Figure 8). Dead trees will continue to fall for years to come and benefit in-stream habitat throughout the burned area. Some wood will be mobilized during flood events and be delivered downstream. Overall, these fires will have a long-term benefit on wood loading in Critical Habitat.

Figure 6. Increased post-fire wood loading in the South Fork McKenzie River.

Figure 7. Increased post-fire wood loading in the South Fork McKenzie River.

Figure 8. Increased post-fire wood loading in tributary drainages within the Terwilliger Fire.

Sediment Delivery

The expected post-fire response includes localized soil movement within the burn area. While erosion is important to assess the impacts to soil productivity it doesn't impact water quality or fish habitat until it makes it to streams or waterbodies. We

did not model sediment delivery to streams, but based on burn severity mapping and field observations, the greatest potential for large amounts of sediment delivery to Critical Habitat is within unstable drainages upstream of roads. These areas of concern were primarily found on Roads 1900 and 1900-500 in the Boone Creek, Slide Creek, and Smith Creek drainages (Figures 9 and 10).

During field evaluations, several road crossings were found to be at risk of plugging, diversion, and road failure due to increases in peak flow and bulking of runoff. Some road segments were set back from the road and have a buffer to capture falling rock, deposit sediment, and allow infiltration. Other segments drain directly to the road edge with the culvert inlet being the first location to deposit sediment. While many of these crossings have controlled drainage in the past, flows in the burn area are expected to increase slightly and more debris is expected to be transported. Several culverts appeared undersized considering the catchment size they are draining. Erosion potential and sediment delivery as well as mobilization of woody debris increase the risk of these culverts failing. Diversion of flows along roads pose a threat to Critical Habitat in the South Fork McKenzie River.

Many drainages that FSR 1900 crosses are very steep and have evidence of pre-fire instability. Instability is likely to increase due to increases in runoff, lack of vegetation, and changes in soil properties. Higher instability will increase the potential for rock fall and debris flow. There are multiple sections on this road that are directly below rock faces with evidence of active rock fall activity.

Figure 9. High and moderate soil burn severity in Boone Creek drainage intercepted by FSR 1900 before entering Cougar Reservoir.

Figure 10. High and moderate soil burn severity in Slide Creek (left) and Smith Creek (right) drainages that are intercepted by FSR 1900-500 before entering Cougar Reservoir.

Risk Determination and Treatment Recommendations for Critical Fisheries Values

Value at Risk	Comments	Probability of Damage[1]	Magnitude of Consequence[2]	Risk Determination	Treatment/ Recommendation
Bull Trout	South Fork McKenzie River and Cougar Reservoir - very important for rearing, foraging, and overwintering; Mass wasting or road failure/diversion could deliver large amounts of sediment which could have detrimental effects to fry, juveniles, and adults	Unlikely	Minor	Very Low	None; Treatments to reduce risk to roads will benefit bull trout
Spring Chinook Salmon	South Fork McKenzie River - very important for spawning and rearing; French Pete Creek - important for spawning and rearing; Cougar Reservoir - important for rearing; Mass wasting or road failure/diversion could deliver large amounts of sediment	Unlikely	Moderate	Low	None; Treatments to reduce risk to roads will benefit Chinook

	which could have detrimental effects to eggs, fry, and juveniles				
Bull Trout Critical Habitat	Increased temperature, flows, sediment, debris flows and nutrient loads may impact habitat and water quality in South Fork and Cougar Reservoir; Mass wasting or road failure/diversion could deliver large amounts of sediment which could have long-term impacts to Critical Habitat; Because there is no bull trout spawning, magnitude of consequence would be Minor	Unlikely	Minor	Very Low	None; Treatments to reduce risk to roads will benefit bull trout CH
Spring Chinook Salmon Critical Habitat	Increased temperature, flows, sediment, debris flows and nutrient loads may impact habitat and water quality; Mass wasting or road failure/diversion could deliver large amounts of sediment which could have long-term impacts to Critical Habitat; Because South Fork is a very important spawning stream, magnitude of consequences would be Moderate	Unlikely	Moderate	Low	None; Treatments to reduce risk to roads will benefit Chinook CH

[1]Probability of Damage or Loss: the relative probability that damage or loss would occur within 1 to 3 years:

- Very likely. Nearly certain occurrence (90% - 100%))
- Likely. Likely occurrence (50% - 89%)
- Possible. Possible occurrence (10% - 49%)
- Unlikely. Unlikely occurrence (0% - 9%)

[2]Magnitude of Consequences:

- Major. Loss of life or injury to humans; substantial property damage; irreversible damage to critical natural or cultural resources.
- Moderate. Injury or illness to humans; moderate property damage; damage to critical natural or cultural resources resulting in considerable or long term effects.
- Minor. Property damage is limited in economic value and/or to few investments; damage to critical natural or cultural resources resulting in minimal, recoverable or localized effects.

VII. REFERENCES

Brown GW, Krieger JT. 1970. Effects of clearcutting on stream temperature. Water Resource Res 4:1133–9.

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U.S. Forest Service. 1997. Horse Creek Watershed Analysis.